

path C to provide some initial compression to the air before entering the low pressure compressor section 444. The inducer 476 rotates at the same rotational speed as the fan 442. [0063] Another example geared architecture 548 for the engine 520 is shown in FIG. 7. The engine static structure 536 supports the inner and outer shafts 540, 550 for rotation about the axis A. The outer shaft 550 supports the high pressure compressor section 552 and the high pressure turbine section 554, which is arranged upstream from the mid turbine frame 559.

[0064] The inner shaft 540 is coupled to the geared architecture 548, which is an epicyclic gear train 560 configured in a differential arrangement. The gear train 560 includes planetary gears 564 supported by a carrier 562, which is connected to the inner shaft 540 that supports the low pressure turbine 546. A sun gear 566 is centrally arranged relative to and intermeshes with the planetary gears 564. A ring gear 570 circumscribes and intermeshes with the planetary gears 564. In the example, a fan shaft 572 is connected to the fan 542. The low pressure compressor 544 is supported by a low pressure compressor rotor 568, which is rotationally fixed relative to the ring gear 570 in the example.

[0065] The carrier 562 is rotationally driven by the low pressure turbine 546 through the inner shaft 540. The planetary gears 564 provide the differential input to the fan shaft 572 and low pressure compressor rotor 568 based upon the geometry ratio. The geared architecture 548 includes an additional speed change device 574 interconnecting the inner shaft 540 and the gear train 560. The speed change device 574 receives rotational input from the sun gear 566 and couples the fan shaft 572 to the gear train 560, which enables slower fan speeds.

[0066] The inducer 576 is fixed for rotation relative to the fan shaft 572. The inducer 576 is arranged in the core flow path C to provide some initial compression to the air before entering the low pressure compressor section 544. In one example, the sun gear 566 rotates at the same speed as one of the fan shaft 572 and the inducer 576, and the other of the fan shaft 572 and the inducer 576 rotate at a different speed than the sun gear 566. In another example, the inducer 576, sun gear 566 and fan shaft 572 rotate at different rotational speeds than one another through the speed change device 574, which is another epicyclic gear train, for example.

[0067] Another example geared architecture 648 for the engine 620 is shown in FIG. 8. The engine static structure 636 supports the inner and outer shafts 640, 650 for rotation about the axis A. The outer shaft 650 supports the high pressure compressor section 652 and the high pressure turbine section 654, which is arranged upstream from the mid turbine frame 659.

[0068] The inner shaft 640 is coupled to the geared architecture 648, which is an epicyclic gear train 660 configured in a differential arrangement. The gear train 660 includes planetary gears 664 supported by a carrier 662, which is connected to the inner shaft 640 that supports the low pressure turbine 646. A sun gear 666 is centrally arranged relative to and intermeshes with the planetary gears 664. A ring gear 670 circumscribes and intermeshes with the planetary gears 664. In the example, a fan shaft 672 is connected to the fan 642. The low pressure compressor 644 is supported by a low pressure compressor rotor 668, which is rotationally fixed relative to the ring gear 670 in the example.

[0069] The carrier 662 is rotationally driven by the low pressure turbine 646 through the inner shaft 640. The plan-

etary gears 664 provide the differential input to the fan shaft 672 and low pressure compressor rotor 668 based upon the geometry ratio. The geared architecture 648 includes an additional speed change device 674 interconnecting the inner shaft 640 and the gear train 660. The speed change device 674 receives rotational input from the sun gear 666 and couples the fan shaft 672 to the gear train 660, which enables slower fan speeds.

[0070] The inducer 676 is arranged in the core flow path C to provide some initial compression to the air before entering the low pressure compressor section 644. The inducer 676 is fixed to the sun gear 666 for rotation at the same rotational speed.

[0071] In the arrangements shown in FIGS. 2-8, the relative rotational directions are shown for each of the fan, low pressure compressor section, high pressure compressor section, high pressure turbine section, low pressure turbine section and inducer. The geared architectures may be configured in a manner to provide the desired rotational direction for a given engine design.

[0072] The example geared architectures enable large fan diameters relative to turbine diameters, moderate low pressure turbine to fan speed ratios, moderate low pressure compressor to low pressure turbine speed ratios, high low pressure compressor to fan speed ratios and compact turbine section volumes. The low pressure turbine section may include between three and six stages, for example.

[0073] The rotational speeds of the sun gear, ring gear and carrier are determined by the geometry ratio of the differential gear train. The interrelationship of these components can be expressed using the following equation:

$$\frac{X_{\text{carrier}}}{X_{\text{ring}}} = \frac{GR}{1 + GR}, \text{ where} \quad (\text{Equation 1})$$

[0074] X_{carrier} is the nomograph distance of the planetary rotational axis from the sun gear axis,

[0075] X_{ring} is the nomograph radius of the ring gear, and

[0076] GR is the geometry ratio. Thus, for a geometry ratio of 3.0.

$$\frac{X_{\text{carrier}}}{X_{\text{ring}}} = 0.75.$$

[0077] The relative sizes amongst the sun gear, planetary gears and ring gear for several different geometry ratios are schematically depicted in FIGS. 9A-9C. Referring to FIG. 9A, the epicyclic gear train 760 includes a sun gear 766, planetary 764, carrier 762 and ring gear 770 that are sized to provide a geometry ratio of 3.0. Referring to FIG. 9B, the epicyclic gear train 860 includes a sun gear 866, planetary 864, carrier 862 and ring gear 870 that are sized to provide a geometry ratio of 2.0. Referring to FIG. 9C, the epicyclic gear train 960 includes a sun gear 966, planetary 964, carrier 962 and ring gear 970 that are sized to provide a geometry ratio of 1.5. In the examples, the ring gear radius remains constant.

[0078] FIG. 10 graphically depicts effects of the geometry ratio on the rotational speeds and directions of the sun and ring gears and the carrier. The upper, lighter shaded bars relate to FIG. 9A-9C. Assuming a rotational input from the low pressure turbine to the carrier of 10,000 RPM, the sun gear